Nineteenth Annual Report

OF THE

North Dakota Agricultural Experiment Station

Agricultural College, North Dakota

TO

The Governor of North Dakota

1909

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LETTER OF TRANSMITTAL.

Agricultural College, N. D., February 1st, 1909.

HON. JOHN BURKE, GOVERNOR OF THE STATE OF NORTH DAKOTA.

SIR: As required by Act of Congress, approved March 2, 1887, I hereby submit the Nineteenth Annual Report of the North Dakota Experiment Station for the year ending February 1st, 1909, together with a financial statement of receipts and disbursements, as required by law, for the government fiscal year ending June 30th, 1908.

Respectfully,

GEO. H. HOLLISTER,
Pres. of the Board of Trustees, N. D., A. C.

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T. D. BECKWITH, M. S., Asst. Bact. and Plant Path.
W. F. SUDRO, B. S., Asst. Chem. (Drugs.)
O. W. DYNES, B. S., Asst. Poultry Husb.
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REPORT

To the Board of Trustees of the North Dakota Agricultural College and Experiment Station:

GENTLEMEN: I have the honor to submit herewith the 19th Annual Report of the North Dakota Government Experiment Station.

The following bulletins were published during the year:

No. 79	The Distribution of Pedigree Seed.	J. H. Shepperd O. O. Churchill
No. 80	Weeds and Methods of Eradication Weed Control by Means of Chemical Sprays.	H. L. Bolley.
No. 81	Practical Paint Tests in 1907.....	E. F. Ladd.
No. 82	Milling and Baking Tests Tests of Flour Sold in North Dakota.....	E. F. Ladd.
No. 83	Pork Production under North Dakota Conditions	W. B. Richards.

THE OUTLOOK

The reports from the several station departments indicate more than usual activity along the several lines of agriculture and associated subjects. Experimentation at best, is slow work as it requires an entire season to study any single phase of plant growth whether for its improvement or to combat fungus, parasitical or other forms of disease. The same may be said of the use of fertilizers, methods of cultivation, or adaptation of different kinds of cereals or forage plants to local conditions.

Crop rotation has occupied and will continue to occupy the attention of the Experiment Station for years to come. Diseases of

livestock have been given more than usual attention and it is proposed to greatly enlarge the scope of investigation during the coming year. Numerous experiments have also been made with different varieties of forest and fruit trees with a view to determine as nearly as possible the most valuable trees and fruits adapted to the soil and climatic conditions of our state.

But little work has been done in dairying owing to the fact that the facilities for doing effective work have been almost entirely wanting. There is a growing demand, however, thruout the state for enlarging the dairy industry and the contemplated work along dairy lines will be greatly extended in the immediate future.

More than usual attention has been given to the destruction of weeds by the use of spraying machines. This method bids fair to become both effective and economical.

Poultry husbandry has been given considerable attention with promising results. Considerable attention has also been given to feeding livestock for the production of beef, pork, etc.

NEW BUILDINGS

The Eleventh Legislative Assembly has appropriated money for the erection and equipment of a veterinary building and also for a new dairy building. When these two buildings are completed and fully equipped, the College and Experiment Station will be in position to do excellent work in the interests of Animal Husbandry and Dairying. It is the purpose of the Department of Dairying to erect a model cow barn and to purchase a herd of about thirty typical dairy cows. These will be fed and handled in a way to determine the type of dairy cow best adapted to local conditions, and the care and feed that will insure the largest financial returns to the dairyman.

SEED BARN

During the past year a commodious and well-equipped seed barn was constructed on the Experiment Station grounds. For eighteen years the Station had no suitable place for storing seeds. During this period the different kinds of grain were stored in sacks which were often mouse eaten. This made it practically impossible to keep the grain from mixing. The bins in the new seed barn are all lined with steel and so constructed that it will be impossible to suffer any damage from the mice. A good sized root-cellar is provided for in the basement of this building for storage of potatoes and other root crops. The building is of brick and is of good size, and fills a long felt want.

EXTENSION EXPERIMENT STATION WORK.

Station work was carried on in fifteen counties of the state, at state expense. Twelve of these were in the form of demonstration farms and three substations were in operation. The new substation at Langdon has been prepared for active operations the coming season. These substations and demonstration farms afford opportunity for testing cereals and forage plants and to practice crop rotations under every possible condition of soil and climate with which our farmers have to contend.

J. H. Worst,
Director.

AGRICULTURAL DEPARTMENT

To Director J. H. Worst:

Sir: The Agricultural Department has made a single change in its workers during the past year, J. C. McDowell resigned to take up farm management work with the United States Department of Agriculture and R. C. Doneghue was elected to fill the vacancy.

The only other changes have been minor ones, which while important in a field where skill in manipulation and an understanding of local conditions are so essential are not of sufficient import to be recorded here.

The work of the Department in livestock feeding lines has been restricted during the past year on account of our having such poor housing facilities as to render the results from possible trials doubtful. With cold housing and muddy yards, one is frequently at a loss to know what to charge to feed and what to exposure.

The correspondence with those interested in questions in grain growing, stock production and farm management has been heavier than during any previous year and is no mean item in accounting for the work of the Department, both in time expended and effect for better agriculture produced.

With experiment work in progress at sixteen different points in the state, in addition to that being carried on at Fargo, the time of the writer is necessarily partitioned to a considerable extent.

Visiting each of the twelve demonstration farms and the four sub-stations requires a month of time spent in inspection work and upon the railroads.

Attending the meeting of the Dry Land Experiment Association also requires a week of time even when it is held upon our own grounds, as arranged the past year.

The Animal Husbandman and the writer have spent considerable time and thought upon the establishment of a co-operative breeding association for Holstein cattle, which has been established in the New Salem district in this state. A considerable of time has also been spent in aiding the Live Stock Breeders' Association in its enterprises and activities. The poultry breeders have also been aided in their work by the Assistant in Animal Husbandry particularly in their public exhibitions.

Fairs have also been given assistance in their judging work and in many other ways. I believe the time spent upon these

lines is productive of as much good as any similar fraction of our time, which is expended and that a failure to render this aid would be a serious error at this early, formative stage of their existence.

The high price for grain which has prevailed for two years has made the advance of the livestock interests more difficult than might have been anticipated. The livestock promoters have strong allies, however, in the perceptible deterioration in productive capacity of old wheat fields, the rapid increase in noxious weed pests, and the rapid annual additions to the acreage of clover. Since the interests of advanced and permanent agriculture are so directly and pertinently dependent upon the livestock and dairy interests of the state, I have felt that all possible encouragement should be given to organized effort on the part of those engaged in enterprises to further such interests.

The institution has been so badly handicapped in the way of equipment for dairy work that little could be done other than to start a record of the cost of milk production by each individual cow contained in the station herd and this has been done.

During the past year two bulletins have been issued by this Department. Number 79 entitled "The Distribution of Pedigreed Seed" is a report of the seed distribution work. It shows that of the seed sent out between the dates 1898 and 1906, 945 different persons received pedigreed seed from the Station. Many of whom have become wide distributing agents in turn, making the total distribution many times that of the person to whom the seed was originally shipped. Reports received from these persons are gratifying as with rare exceptions, the seed has given them markedly better returns than the strains, which they have displaced. In this state with its wide range of soil and sub-soil types, with its wide ranges of rainfall, drainage and other features affecting the crop, yields and general behavior, the work of making and thoroly testing out varieties for the different sections of the state, is a feature of work, which must be continued for a long period of time before it can be considered even tentatively worked out.

Bulletin No. 83 entitled "Pork Production Under North Dakota Conditions" is a bulletin of information giving the features of information needed by a beginner and by those who have not had experience in pig growing in this climate. This bulletin is proving very useful to old and experienced pig raisers—according to their reports—who have not kept themselves informed on all of the later methods devised for economic pork production.

Farm management or crop rotation is a line of work, which needs the results of the trials now being made on the grounds of the seventeen demonstration farms and experiment stations located at as many points in the state and this data must needs cover a long

period of time before many of the fundamental principles can be worked out.

The questions whether beef cattle can be profitably finished in this state, whether they can best be simply "warmed up" so that they are prime feeders or fair butcher stuff, or if the best plan for this country is to use them to consume our cheap roughage and sell them as feeders to be finished further east, are vital questions which are pressing for solution. For the present, however, our housing facilities will not accommodate the cattle needed for class room demonstration work, so that the carrying on of such features of investigation—vital as they are -must wait until suitable provision can be made for additional stock before they can be satisfactorily studied.

The same is true of sheep feeding work in all of the details named, and in addition, there are numerous "grazing off" problems with this class of stock which need investigation. The value of rape for fattening sheep—can corn be grazed off satisfactorily—how much mutton will an acre of wheat stubble gleanings produce and how will spelt and barley respectively compare with corn as fattening grains for sheep, are some of the questions which are seeking an answer. Slight relief is obtained thru the utilization of a straw shed, which supplies additional housing, but of a sort which is far from suitable. Nearly identical problems with hogs are being worked out at the present time and it is showing its effects upon the swine interests already. Hogging off of peas and rape by fattening hogs are trials which are under way now, and are giving unusually good returns.

The breeding of field crops is a vital line of experiments which is being vigorously prosecuted. With the newly added facilities, in the form of a new seed house just completed, I anticipate that a better grade of work in that line will be possible. The demand for and interest and faith in pedigree seeds on the part of the grain growers in the state is rapidly increasing so that no energy need be expended in popularizing or making arguments concerning the importance of it. The energies of the station can now be expended wholly upon the production of improved forms of grain, grass, and forage plants.

The growth of clover is now common and trials with alfalfa in the state are numerous. The interest in these subjects and in the growing of Indian corn is so great that numerous vital problems in culture as well as breeding confront us.

Winter wheat and rye among the cereals are now interesting our grain growers largely, and notwithstanding the fact that the station has been working with these grains for about ten years, much additional work is being undertaken in these lines, to secure the needed data. Winter grains have such a strong bearing upon

questions of rotation and the destruction of weeds as to form an added reason for extending their culture in the state.

The rotation trials are being revised and added to as the growing of legumes, grasses, and winter grain in this state make it necessary to include them in many combinations in the management of farm crops.

Closely connected with these problems of crop rotation are those of soil moisture conservation and the introduction of humus forming manures to note their effect upon the physical properties of the soil and the productiveness of the gumbo and clay types of soil in the state.

The problem of tile drainage is being given large attention as the Red River Valley district in this state which is one of our most productive regions is sadly in need of tile drainage, if a satisfactory plan for it can be worked out. Many problems have arisen in connection with tile drainage which have a vital relation to its value.

The strains of seed distributed this season are as follows

North Dakota No. 388 Oats—Tartarian.
" " " 666 Oats—Sixty Day.
" " " 871 Barley—Mandscheuri.
" " " 155 Flax.
" " " 959 Winter Rye.

Following is the report of the grain yield upon the farm for 1908:

Field	Crop	No. of acres	Yield per A.	Grand Total
NE¼ of NW¼	871 barley	10	33.3	1333.5
SW¼ of NW¼	388 oats	20	52.48	1050.
NW¼ of NW¼	666 oats	30	39.9	1197.

The balance of the farm was chiefly in hay and pasture. The hay was stacked in the fields largely, and has not all been weighed in yet, so that the yields are not yet a matter of record. Fifty acres in the N. E. quarter was used for a combination of pedigree grain and a tile drainage trial. This fifty acres of land was divided between emmer, 388 oats, 666 oats, 871 barley, 155 flax and 950 corn. The yields were made uncertain by hail beating out some of the grain, while it was in the field.

Poultry work is being prosecuted along the following lines of study:

The Cost of Egg Production.
The Effect of Confinement upon Egg Production.
Breeding for High Egg Production.

Effect of In-breeding upon Size, Egg Production, Fecundity, and General Vigor.
Effect of the Age of Eggs upon Their Incubation.
Effect of Chilling upon the Incubation of Eggs.
Natural Versus Artificial Incubation.
Grade Breeding Experiments and Demonstration.
Following is the poultry production and sale report for 1908:

EGG RECORD BY MONTHS.

January	285
February	745
March	964
April	2312
May	2357
June	1605
July	1362
August	1855
September	1574
October	508
November	96
December	98
	13,761 or 1,146 doz.

EGGS SUPPLIED TO FARMHOUSE

January—40⅔ doz. at 30 cts.	$ 12.20
February—44 doz. at 30 cts.	13.20
March—58½ doz. at 20 cts.	11.70
April—74½ doz. at 15 cts.	11.17
May—89⅓ doz. at 16 cts.	14.29
June—95¾ doz. at 18 cts.	17.23
July—100¼ doz. at 18 cts.	18.04
August—107 doz. at 18 cts.	19.26
September—85½ doz. at 20 cts.	17.10
October—52 doz. at 25 cts.	13.00
November—41¼ doz. at 30 cts.	12.37
December—36½ doz. at 30 cts.	10.95
Total 825¼ doz.	$170.51

SALES FOR YEAR 1908.

Breading Stock	$ 64.00
Eggs for hatching	26.00
Market Eggs	10.89
Eggs for Domestic Science Department	7.41
Poultry for farmhouse, 561 lbs. at 10 cts	56.10
	$164.40

TOTALS

Farmhouse Eggs	$170.51
Sales	164.40
	$334.91

POULTRY INVENTORY JANUARY 1, 1908.

Kind of Stock	R. C. B. Leg.	B. P. Rocks	Grades	Butcher Stock	Tot.
Pullets	15	87	....	....	102
Hens	17	75	26	7	125
Males	1	21	....	....	22
Totals	33	183	26	7	249

Value of Breeding stock unsold, $100.00.

I hereby tender my thanks to the following men who have assisted me in carrying the wrok of the department during the past year: W. B. Richards has taken the responsibility for the detail of the general livestock work. Oliver Dynes has carried out the detail of the poultry trials and has had large responsibility in that work. O. O. Churchill has taken charge of the detail of the plant breeding and field crop experiments. William R. Porter has superintended the demonstration farm work and has carried large responsibility in connection with them. R. M. Dolve has worked out the detail of the tile drainage and farm machinery trials conducted by the station. C. M. Hennis has carried the work of farm foreman during the year.

The efficient, conscientious aid of these young men have made the work encompassed by this department during the past twelve months possible.

Respectfully submitted,

J. H. SHEPPERD.

CHEMICAL DEPARTMENT

To J. H. Worst, Director:

Sir: I herewith present my Nineteenth Annual Report as Chemist of the North Dakota Government Agricultural Experiment Station for the calendar year of 1908. The work of this department during the past year has covered a wide range of subjects, and increased to a considerable extent over that of previous years. The amount of correspondence has been large and covered a great variety of subjects, often requiring the looking up and collecting of considerable data before the letters could be answered. The number of personal letters for the year amounted to 4,900, and this does not include the large number of circular letters which have been prepared and sent out, as have also two reports been prepared and submitted to the County Auditors of the state, as required under the Food Law of the State.

During the past year this Department has prepared and published four bulletins and four press circulars. Bulletin No. 81 deals with experimental work in the testing of paints in a practical way. This bulletin contains 138 pages and deals with two classes of experiments: First, Experiments with special paints containing nearly all classes of pigments generally used in the manufacture of paints; Second, With white leads and lead substitutes. The report is, preliminary, and final results can only be seucred after years of exposure.

Bulletin No. 82, containing 86 pages, treats of milling and baking tests with wheats and flours; also with tests of flours commercially sold in North Dakota. This is the first of a series of bulletins to be prepared, as required under a special act of the Legislature of the State of North Dakota for 1905, requiring the Experiment Station to conduct certain lines of investigation with wheats, flours and the bread made therefrom.

Special bulletin No. 9 deals with the subject of bleached flour and the investigational work carried out in the study of the same.

Special bulletin No. 10 gives an outline of the Model Food Law Bill and the Bill for Sanitary Inspection where food products are prepared, stored or handled.

Part II, of the present report includes the results of investigations made under the Pure Food Law, Drug Law, Patent Medicine Law, some of the results of investigations made with regard to paints and various miscellaneous experiments undertaken during the year.

SUMMARIES OF TEMPERATURE AND RAINFALL.

Since the opening of the Station eighteen years ago, meteorological records have been maintained. The data for each year has been published in preceding annual reports, and for the present year we present the following:

TEMPERATURE AND RAINFALL FOR 1908.

Month	Mean	Maximum	Mean of Maxima	Minimum	Mean of Minima	Rainfall In inches
January	14.48	55	24.45	-1	5.06	.01
February	15.00	39	23.13	-1	6.75	.03
March	23.35	52	31.54	0	13.16	.52
April	45.00	80	56.7	6	33.23	.58
May	53.41	80	64.5	20	42.35	3.02
June	61.93	86	71.56	33	52.3	2.60
July	70.22	97	82.25	43	57.9	2.78
August	65.32	97	79.00	35	51.64	2.55
September	63.00	94	76.00	26	50.00	2.54
October	45.74*	80	57.00	19*	35.74*	.74
November	35.5	64	40.00	7	24.00	2.39
December	14.17	39	22.48	2	6.00	.22
Totals&Me.	42.26		52.38		31.51	18.98

*Record lost for one day of the month.

The mean annual temperature for a number of years preceding 1906 averaged 39.40°. In 1906 the average was quite a little above the mean temperature, being 47.3° at this Station; while the average for 1908 has been 42.26°, or quite a little above that for 1907, which was 37.26°, or below the mean average.

Summarizing our results for temperature we have:

Mean of temperature for 1906	47.3 °
Mean of temperature for 1907	37.26°
Mean of temperature for 1908	42.26°
Mean of maxima temperature for 1907	48.02°
Mean of maxima temperature for 1908	52.38°
Mean of minima temperature for 1907	26.85°
Mean of minima temperature for 1908	31.51°
Maximum temperature registered July 10th	97.00°
Minimum temperature registered Jan. 29th	29.00°
Range of temperature for 1908	126.00°

The rainfall for 1908 was 18.98 inches as compared with 15.34 inches for 1907, and a maximum of 30.76 inches for 1905. The

average rainfall for the fifteen years preceding 1907 was 21.36 inches. The annual rainfall by years since 1892 is shown in the following:

	1892	1893	1894	1895	1896
Rainfall, inches	20.73	16.17	18.72	16.05	21.77
	1897	1898	1899	1900	1901
Rainfall, inches	22.50	16.36	21.20	25.54	25.68
	1902	1903	1904	1905	1906
Rainfall, inches	23.16	23.81	20.26	30.76	17.70
	1907	1908			
Rainfall, inches	15.34	18.98			

For the past sixteen years the minimum rainfall has been 15.34 inches in 1907, and the maximum rainfall 30.76 inches in 1905.

MONTHLY RECORDED SUNSHINE.

As in the past, the record of the sunshine has been taken by means of a Friez Photographic Record, but no correction has been made for early morning and evening sunshine in the record, which has been estimated to amount, approximately, to 12% more than the recorded sunshine.

SUNSHINE RECORD 1908.

	Total Hours		Hours of Daily Means		Percentage of Possible Sunshine
	Possible	Recorded	Possible	Recorded	
January	279.1	126.0	9.00	4.06	45.35
February	298.1	124.8	10.2	4.3	41.59
March	369.0	153.3	11.9	4.9	41.10
April	407.3	223.0	13.5	7.4	55.43
May	456.3	189.0	14.6	6.09	40.99
June	475.0	219.9	15.83	7.33	46.67
July	480.2	312.3	15.4	10.00	64.83
August	441.8	247.5	14.25	7.98	55.90
September	378.3	200.7	12.6	6.69	52.47
October	337.6	126.6	10.89	4.06	37.00
November	281.6	103.2	9.38	3.44	36.86
December	267.1	85.8	8.61	2.76	32.05
Means	372.6	176.0	12.18	5.75	45.85

RECORD OF WIND VELOCITY.

A Friez Wind Gage and Aneometer Register are employed for

recording the wind velocity, the data for which is presented in the following table:

Date	JANUARY			FEBRUARY		
	Total M.	Mean Vel.	Max. Vel.	Total M.	Mean Vel.	Max. Vel.
1.	107	4.4	12	284	11.8	17
2.	256	10.7	23	357	14.9	23
3.	415	17.3	20	160	6.6	23
4.	255	10.6	20	436	18.2	26
5.	392	16.3	38	489	20.4	36
6.	654	27.2	38	290	12 0	12
7.	432	18.0	24	262	10.9	18
8.	225	9.4	34	416	17.3	23
9.	401	16.7	15	339	14.1	21
10.	235	9.8	14	465	19.4	32
11.	201	8.4	14	633	26.4	31
12.	226	9.4	17	319	13.3	26
13.	151	6.3	25	234	9.7	17
14.	452	18.7	40	233	9.7	18
15.	669	27.8	37	210	8.7	23
16	368	15.3	24	310	12.9	15
17.	367	15.3	16	119	4.9	18
18.	376	15.7	25	386	16.0	23
19.	353	14.7	15	238	9.9	26
20.	329	13.7	27	420	17.5	25
21.	442	18.4	32	262	10.9	28
22.	457	19.0	31	468	19.5	26
23.	439	18.3	29	255	10.4	25
24.	379	15.8	14	365	15.2	30
25.	186	7.7	26	583	24.3	31
26.	426	17.7	28	487	20.3	21
27.	435	18.1	41	286	11.9	19
28.	512	21.3	26	276	11.5	15
29.	248	10.3	19	246	10.2	17
30.	167	6.9	24			
31.	512	21.3	29			
Means & Totals	11067	14.85	25	9929	14.1	23

Date	MARCH			APRIL		
	Total M.	Mean Vel.	Max. Vel.	Total M.	Mean Vel.	Max. Vel.
1.	316	13.1	21	766	31.9	43
2.	197	8.2	21	372	15.5	21
3.	303	12.6	12	222	9.2	30
4.	257	10.7	20	587	24.4	28
5.	333	13.9	31	342	14.2	23
6.	421	17.5	27	329	13.7	19
7.	444	18.5	32	305	12.7	20
8.	327	13.4	24	370	15.4	28
9.	206	8.6	22	583	24.3	40
10.	415	17.3	25	579	24.1	34
11.	238	9.9	20	398	16.6	27
12.	506	21.0	37	337	14.0	31
13.	384	16.0	29	525	21.9	30
14.	339	14.1	18	579	24.1	39
15.	244	10.1	21	380	15.8	32
16.	465	19.4	30	515	21.4	32
17.	198	8.2	17	476	19.8	34
18.	349	14.5	19	503	20.9	40
19.	288	12.0	24	334	13.9	23
20.	380	15.8	21	220	9.1	26
21.	415	17.3	25	616	25.7	41
22.	380	15.8	26	312	13.0	27
23.	576	24.0	29	449	18.7	31
24.	349	14.5	33	342	14.2	29
25.	610	25.4	37	573	23.9	33
26.	346	14.4	14	624	26.0	33
27.	270	11.2	17	665	27.7	35
28.	251	10.4	23	595	24.8	30
29.	425	17.7	25	280	11.7	21
30.	421	17.5	30	342	14.2	31
31.	473	19.7	44			
Means & Totals	11126	14.9	25	13520	18.7	30

Date	MAY*			JUNE**		
	Total M.	Mean Vel.	Max. Vel.	Total M.	Mean Vel.	Max. Vel.
1.	559	23.3	31	381	15 9	24
2.	246	10.2	13	339	14.1	19
3.	227	9.4	16	305	12.7	28
4.	265	11.0	18	545	22.7	32
5.	279	11.6	21	424	17.7	29
6.	317	13.2	22	481	20.0	31
7.	268	11.1	20	240	10.0	25
8.	195	8.1	13	466	19.4	22
9.	129	5.4	14	288	12.0	17
10.	323	13.4	24	257	10.7	22
11.	268	11.1	19	495	20.6	28
12.	243	10.1	21	301	12.5	31
13.	343	14.3	20	472	19.7	28
14.	437	18.2	34	237	9.9	21
15.	159	6.6	11	372	15.5	26
16.	234	9.7	33	371	15.4	26
17.	443	18.4	30	480	20.0	39
18.	359	14.9	23	575	23.9	41
19.	350	14.6	39	516	21.3	34
20.	608	25.3	22	382	15.9	27
21.	337	14.0	26	282	11.7	21
22.	374	15.6	23	265	11.0	20
23.	127	5.3	13	Lost	Lost	Lost
24.	206	8.5	22	Lost	Lost	Lost
25.	206	8.6	22	Lost	Lost	Lost
26.	350	14.6	21	574	23.9	36
27.	Lost	Lost	Lost	316	13.1	34
28.	Lost	Lost	Lost	462	19.2	33
29.	382	15.9	21	297	11.5	18
30.	332	13.8	20	270	11.2	19
31.	141	5.9	20			
Means & Totals	8807	12.5	22	10393	15.9	27

* Records lost for two days in May.

** Records lost for three days in June.

Date	JULY			AUGUST*		
	Total M.	Mean Vel.	Max. Vel.	Total M.	Mean Vel.	Max. Vel.
1.	122	5.0	9	196	8.1	22
2.	188	7.8	14	352	14.7	22
3.	303	12.6	28	246	10.2	21
4.	414	17.2	32	286	11.9	22
5.	211	8.8	18	228	9.5	14
6.	229	9.5	17	196	8.1	14
7.	262	10.9	19	101	4.2	19
8.	290	12.0	32	241	10.0	18
9.	456	19.0	36	215	8.9	12
10.	112	4.7	14	178	7.4	17
11.	172	7.1	10	263	10.9	18
12.	206	8.6	14	109	4.5	21
13.	130	5.4	11	307	1.3	14
14.	161	5.7	14	136	5.7	9
15.	339	14.1	22	115	4.8	11
16.	174	7.2	22	Lost	Lost	Lost
17.	253	10.5	21	Lost	Lost	Lost
18.	236	9.8	18	409	17.0	24
19.	302	12.6	21	194	8.0	27
20.	284	11.8	21	444	18.6	29
21.	164	6.8	13	397	15.7	29
22.	211	8.8	12	166	6.9	10
23.	140	5.8	18	145	6.0	11
24.	371	15.4	22	262	10.9	19
25.	382	15.9	18	Lost	Lost	Lost
26.	281	11.7	17	476	19.8	28
27.	183	7.7	10	371	15.4	26
28.	294	12.2	23	155	6.4	21
29.	260	10.8	21	358	14.9	26
30.	255	10.6	17	573	23.9	43
31.	297	12.4	22	478	19.9	32
Totals & Means	7682	10.2	19	7597	11.2	20

* Records for three days lost.

Date	SEPTEMBER*			OCTOBER		
	Total M.	Mean Vel.	Max. Vel.	Total M.	Mean Vel.	Max. Vel.
1.	381	15.9	25	357	14.9	38
2.	417	17.4	32	740	30.8	35
3.	465	19.4	30	242	10.0	27
4.	203	8.4	22	466	19.4	30
5.	438	18.2	35	523	21.8	36
6.	198	8.2	37	370	15.4	23
7.	638	26.6	34	187	7.8	20
8.	445	18.5	18	333	13.9	24
9.	148	6.1	19	517	21.5	33
10.	307	12.8	17	549	22.9	30
11.	176	7.3	13	263	10.9	31
12.	204	8 .5	16	635	26.4	36
13.	Lost	Lost	Lost	376	15.7	16
14.	Lost	Lost	Lost	362	15.0	23
15.	494	20.6	24	139	5.8	17
16.	545	22.7	32	387	16.1	27
17.	261	10.9	17	487	20.3	23
18.	157	6.5	11	246	10.2	24
19.	196	8.2	17	537	22.4	38
20.	205	8.5	29	693	28.9	40
21.	456	19.0	37	383	15.9	27
22.	426	17.7	31	323	13.4	18
23.	206	8.6	21	152	6.3	22
24.	433	18.0	35	424	17.7	29
25.	306	11.9	25	656	27.3	28
26.	429	17.9	21	499	20.8	25
27.	362	15.0	23	256	10.7	16
28.	403	16.8	31	342	14.2	19
29.	422	17.6	30	250	10.4	16
30.	350	13.3	16	179	7.4	18
31.				316	13.1	20
Totals & Means	9671	14.3	24	12189	16.3	26

* Records for 2 days lost.

Date	NOVEMBER			DECEMBER		
	Total M.	Mean Vel.	Max. Vel.	Total M.	Mean Vel.	Max. Vel.
1.	264	11.0	19	434	18.0	21
2.	382	15.9	34	293	12.2	17
3.	524	21.8	25	387	16.1	28
4.	302	12.6	24	224	9.3	12
5.	426	17.7	18	276	11.5	21
6.	252	10.5	18	380	15.8	26
7.	281	11.7	40	343	14.3	15
8.	658	23.2	39	233	9.7	14
9.	296	12.3	19	331	13.8	28
10.	238	9.9	24	453	18.9	27
11.	442	18.4	23	283	11.8	29
12.	477	19.9	23	445	18.5	33
13.	472	19.7	27	287	11.9	19
14.	226	9.0	27	283	11.2	13
15.	473	19.7	25	97	4.0	9
16.	277	11.5	20	149	6.2	20
17.	310	12.9	25	431	17.9	24
18.	326	13.6	22	407	16.9	31
19.	184	7.6	22	468	19.5	34
20.	389	16.2	27	508	21.1	30
21.	351	14.6	21	318	13.2	23
22.	165	6.9	16	278	11.6	21
23.	322	13.4	17	261	10.9	11
24.	322	13.4	16	190	7.9	20
25.	263	10.9	25	352	14.7	36
26.	505	21.0	28	666	23.6	34
27.	366	15.2	19	361	15.0	30
28.	323	13.4	24	269	11.2	25
29.	328	13.7	38	524	21.7	46
30.	581	24.2	43	859	35.8	42
31.				375	15.6	25
Totals & Means	10725	14.7	25	11175	14.8	25

The total number of miles recorded for the year ending December 31st, have been as follows:

January	11,067	
February	9,929	
March	11,126	
April	13,520	
May	8,807	*
June	10,393	**
July	7,682	
August	7,597	***
September	9,671	****
October	12,189	
November	10,725	
December	11,175	
Total	123,881	

* Records lost for two days in May.
** Records for three days lost in June.
*** Records lost for three days in August.
**** Two days records lost for September

For the 356 days record the velocity averaged 348 miles per day, or 16 miles per hour. At the same rate for the ten days unrecorded the total miles for the year would be 127,361 miles.

EVAPORATION FROM WATER SURFACE

For the past seven summers there has been kept a record showing the daily evaporation of water from a water surface for the principal growing months. This work is carried on in connection with the soil experiments and the study of plant nutrition for the purpose of gaining information with regard to the movement of water in the soil.

The method pursued has been described in previous reports and need not be repeated. The following table shows the amount of water evaporated daily, expressed in inches:

Date	May	June	July	August	September
1	.2	.2	.25	.25	.1
2	.05	.0	.11	.53	.3
3	.45	.05	.14	.63	.2
4	.3	.11	.27	.55	.3
5	.35	.27	.18	.55	.3
6	.25	.06	.3	.2	.3
7	.3	.18	.4	.4	.3
8	.4	.1	.02	.28	.3
9	.3	.13	.38	.4	.1
10	.46	.17	.4	.5	.2
11	.2	.22	.4	.6	.1
12	.2	.18	.5	.5	.2
13	.4	.2	.4	.6	.2
14	.03	.1	.2	.02	.1
15	.03	.3	.55	.1	.1
16	.0	.3	.3	.5	.25
17	.21	.3	.39	.5	.25
18	.32	.0	.19	.68	.1
19	.3	.03	.3	.6	.1
20	.33	.0	.4	.3	.1
21	.03	.2	.3	.4	.3
22	.02	.25	.43	.35	.2
23	.3	.15	.08	.35	.2
24	.0	.03	.28	.3	.1
25	.1	.25	.45	.24	.26
26	.1	.1	.01	.2	.08
27	.1	.35	.08	.6	.0
28	.09	.2	.2	.6	.0
29	.06	.25	.3	.05	.14
30	.0	.15	.2	.26	.02
31	.2		.48	.2	
Totals & Average	6.08 .20	4.83 .16	8.89 .26	12.24 .49	5.20 .17

The total amount of water evaporated from a water surface for the five months, May, June, July, August and September, was 37.24 inches; a monthly average of 7.45 inches, or a daily average of .24 inches.

A summary for the past six years is shown by months in the following table:

INCHES OF EVAPORATION

Month	1902	1903	1904	1905	1906	1907	1908
May	6.48	4.30	6.40	4.37	3.63	4.53	6.08
June	5.75	8.69	5.40	5.60	3.57	5.02	4.83
July	4.77	13.26	8.05	6.67	5.84	4.96	8.89
August	6.62	12.07	8.30	6.51	5.21	3.70	12.24
Sept.	4.50	3.55	2.29	3.28	4.11	2.46	5.20
Total	28.12	41.87	30.44	26.43	22.36	20.67	37.24

For the past seven years there is shown a very wide range of evaporation from a water surface. When this data is examined in connection with other meteorological data, especially with sunshine and relative humidity of atmosphere, there is offered much instructive information and there is given us a clue as to the probable movement of soil moisture.

The rainfall by months for the same period has been as follows:

INCHES OF RAINFALL

Month	1902	1903	1904	1905	1906	1907	1908
May	4.25	2.78	1.47	5.77	3.03	1.57	3.02
June	3.97	.56	3.83	5.00	3.11	3.12	2.60
July	2.54	2.62	2.83	5.17	2.68	2.39	2.78
August	2.95	4.61	.69	6.82	2.22	2.84	2.55
Sept.	1.61	5.61	3.49	3.47	1.18	3.90	2.54
Total	14.32	16.18	12.30	26.23	12.22	13.82	13.49

The difference in the rainfall as compared with evaporation for the several years, which is indicated in the following table, is of special interest:

EVAPORATION TIMES THE RAINFALL.

1902	1.96
1903	2.58
1904	2.47
1905	1.003
1906	1.829
1907	1.489
1908	2.76

This table indicates a wide range during the past six years, and it is necessary in studying this data to take into consideration the matter of sunshine, temperature and wind which are quite different for the several years, and so to a considerable extent modify the rate of evaporation.

ANALYSIS OF FORMALDEHYDE.

Every sample of formaldehyde sold or offered for sale in this state as a fungicide should contain 40% by weight of formaldehyde. If it falls below 38% it shall be deemed adulterated. It is made the duty of the Experiment Station to see that this law is enforced, and the work thus far has devolved upon the chemical department.

Under the law of the state manufacturers or jobbers of formaldehyde doing business in North Dakota are required to secure a license for the sale of formaldehyde, which license is furnished by the Experiment Station on application by the jobber or manufacturer, and the depositing of a sample labeled to comply with the requirements of the law. No charge is made for such a license.

In 1908, owing to the fact that the U. S. P. established a standard of 37% of formaldehyde by weight, the large jobbing houses and manufacturers overlooked the requirements of the North Dakota law and furnished a product intended to comply with the requirements of the U. S. P.

The experimental work in the state which has led to the use of formaldehyde as a fungicide for the destruction of smut in wheat, is based on experiments made with formaldehyde ranging from 38% to 40% in strength. Therefore, a formaldehyde weaker than this does not come up to the requirements for destroying smut. Where a minimum amount of formaldehyde and a maximum of water has been used, as has previously been recommended, the results might be unsatisfactory.

Early in the season of 1908 the following press circular was given out:

FORMALDEHYDE NOTICE

Press Circular No. 2.

Several samples of formaldehyde have recently been examined, as furnished by jobbers, and found to be low in strength. Druggist and dealers in formaldehyde should see that they have a guarantee, and that the product complies with the requirements of the Formaldehyde Law, and contains not less than 38 per cent by weight of formaldehyde.

My advice is to purchase of dealers of recognized standing.

Druggists should send samples to the Chemical Department, Agricultural College, N. D., for free analysis to determine the true strength before offering the same for sale.

If your formaldehyde is badly polmerized, that is, heavy or milky in appearance, do not sell it to the farmers for treating wheat for smut. It will not destroy the smut and may kill the wheat germ.

Containers for formaldehyde should be well shaken occasionally so as to redissolve any which has become polmerized. Formaldehyde which forms a clear solution does not lose strength on keeping, even tho not tightly corked. Farmers using large quantities should send samples for analysis, and buy only of reliable dealers.

In sending samples, be sure to have the name and address on the bottle. Many fail to do this and receive no report for we are not able to trace the sample.

(Signed) E. F. LADD,
Fargo, N. D., March 10, 1908. *Food Commissioner*

A further examination showed that the formaldehyde would not test the required amount, and the druggists declined to handle the same. But, inasmuch as other formaldehyde could not be had, the information contained in press circular No. 6 was given out under date of March 31st, 1908.

FORMALDEHYDE NOTICE

Press Circular No. 6.

Most of the formaldehyde thus far examined has been found to contain from 37 to 38 per cent of formaldehyde by weight. This is classed as not standard, altho usable.

To answer the question asked by druggists and farmers, I would say that formaldehyde marked as not standard, therefore, not less than 37 per cent by weight in strength, is safe to use for destroying smut; and I would recommend that of this formaldehyde 1 pound avoirdupois to 40 gallons of water be employed for the present year.

The producers of a large share of the formaldehyde offered for sale in this state, it seems, made the formaldehyde of a strength to conform with the requirements of the new U. S. P., which is not the legal strength in North Dakota. Therefore, for the present year little, if any, formaldehyde shipped into the state is full strength under our State Law. The formaldehyde as tested and marked "not standard" is pure but not of desired strength and can be used with safety 1 pound to 40 gallons for wheat. I would advise that you so recommend to farmers.

(Signed) E. F. LADD,
Fargo, N. D., March 31, 1908. *Commissioner.*

During the past year 127 samples of formaldehyde were analyzed with results as indicated by the following table:

Lab. No.	CONTRIBUTORS AND THEIR ADDRESSES	Percent
694	The International Chemical Co., Chicago, Ill.	36.3
695	The International Chemical Co., Chicago, Ill.	37.16
696	Noyes Bros. & Cutler, St. Paul, Minn.	38.7
697	Minneapolis Drug Co., Minneapolis, Minn.	38.3
698	The International Chemical Co., Chicago, Ill.	35.85
699	The International Chemical Co., Chicago, Ill.	36.0
700	Standard Chemical Co., St. Henri de Montreal, Can.	38.20
701	International Chemical Co., Chicago, Ill.	38.00
702	The International Chemical Co., Chicago, Ill.	38.30
703	Pingree Drug Co., Pingree, N. D.	35.40
704	Finley Drug Co., Finley, N. D.	37.60
705	C. A. Hawkins, Hillsboro, N. D.	37.18
706	Garnett Bros., St. Thomas, N. D.	37.53
707	Robert Swanlow, Milton, N. D.	37.85
708	City Drug Store, Lansford, N. D.	37.16
709	Johnson & Co., Cando, N. D.	38.04
710	Jos. Pazandak, Fullerton, N. D.	39.34
711	Mike & Glarum, Underwood, N. D.	37.81
712	C. W. Todd, Carpio, N. D.	37.01
713	Jewett Drug Co., Aberdeen, S. D.	37.32
714	Amos Abbott & Co., Langdon, N. D.	37.38
715	The Beach Drug Co., Beach, N. D.	39.26
716	Jewett Drug Co., Aberdeen, S. D.	37.62
717	Ganssle & Grant, St. Thomas, N. D.	37.53
718	E. C. Krueger, Bowbells, N. D.	37.75
719	Berthold Drug Co., Berthold, N. D.	38.58
720	McCoy, The Druggists, Minot, N. D.	38.37
721	A. M. Reite, Portal, N. D.	38.32
722	Wolford Drug Co., Wolford, N. D.	38.51
723	Rolf Reite, Noonan, N. D.	37.73
724	Great Bend Pharmacy, Great Bend, N. D.	37.45
725	Mohall Pharmacy, Mohall, N. D.	37.83
726	The Dickey Pharmacy, Dickey, N. D.	35.01
727	Ottis & Strehlow, Wyndmere, N. D.	38.02
728	The Meredith Drug Co., Fargo, N. D.	37.48
729	Inkster Drug Co., (?) Inkster, N. D.	36.95
730	Granville Drug Co., Granville, N. D.	37.53
731	H. H. Bateman, Cooperstown, N. D.	38.44
732	Ganssle & Grant, St. Thomas, N. D.	37.62
733	A. Kraft & Co., Hoople, N. D.	36.61
734	A. Kraft & Co., Hoople, N. D.	37.25
735	Barton Drug Co., Barton, N. D.	37.97

736	Stuart G. Watt Drug Co., Sarles, N. D.	39.20
737	Pingree Drug Co., Pingree, N. D.	36.87
738	McQuarrie & Hellbach, Walhalla, N. D.	37.66
739	Inkster Drug Co., Inkster, N. D.	36.66
740	J. W. Robinson & Co., Cole Harbor, N. D.	37.99
741	E. F. Bodle Drug Co., Ellendale, N. D.	36.26
742	O. E. Holmes, Kensal, N. D.	37.99
743	J. Steinberger, Donnybrook, N. D.	37.44
744	Jewett Drug Co., Aberdeen, S. D.	37.35
745	Jewett Drug Co., Aberdeen, S. D.	37.41
746	B. B. Bennett, Drake, N. D.	39.08
747	Webster Pharmacy, Webster, N. D.	37.88
748	Ray Drug Co., Ray, N. D.	37.48
749	Harvey Mercantile Co., Harvey, N. D.	37.52
750	Hardy Bros., Fairview, Mont.	38.68
751	Lee & Hart, Deering, N. D.	37.16
752	Robert Swanlow, Milton, N. D.	37.96
753	M. D. Butler & Co., Brocket, N. D.	39.03
754	H. W. Boock, Crosby, N. D.	38.44
755	Caroline & Bell, Minto, N. D.	38.82
756	Burgess & Wold, Bisbee, N. D.	37.94
757	Burgess & Wold, Bisbee, N. D.	37.37
758	Palace Drug Store, Lankin, N. D.	38.13
759	J. J. Poole & Co., Perth, N. D.	38.72
760	J. J. Poole & Co., Perth, N. D.	37.11
761	J. J. Poole & Co., Perth, N. D.	38.31
762	J. J. Poole & Co., Perth, N. D.	38.48
763	Ramsey Drug Co., Devils Lake, N. D.	37.11
764	Dr. W. Van de Orve, Pingree, N. D.	37.18
765	Amos Abbott & Co., Langdon, N. D.	37.45
766	Wm. G. Buehring, Anamoose, N. D.	35.56
767	John Martin, Chaffee, N. D.	37.23
768	L. D. Carlson, Lansford, N. D.	38.24
769	Miss Isabelle Hoffman, Georgetown, Minn.	36.52
770	H. A. Gallegly, Dazey, N. D.	36.71
771	Bruno Kretschner, Kramer, N. D.	28.88
772	W. S. Parker, Lisbon, N. D.	37.69
773	S. Almklov, Cooperstown, N. D.	39.31
774	B. B. Bennett, Drake, N. D.	37.05
775	John O. Hamre, Edmore, N. D.	37.22
776	A. W. Drew, Davenport, N. D.	37.18
777	Ingli Wold, Martin, N. D.	37.89
778	Willis Smith, Jamestown, N. D.	37.91
779	A. Kraft & Co., Hoople, N. D.	37.92
780	J. M. Webb, McHenry, N. D.	37.07
781	Frank Fay, York, N. D.	38.30
782	Wonnenberg & Avis, Jamestown, N. D.	37.75

783	Williams Pharmacy, Larimore, N. D.	38.14
784	J. E. Fladeland, Portland, N. D.	38.08
785	O. Almklov, Hannaford, N. D.	37.93
787	Olson Drug Co., Fingal, N. D.	37.60
788	Rollef Berg, Courtney, N. D.	36.60
789	S. E. Arthur, York, N. D.	37.84
790	Fessenden Drug Co., Fessenden, N. D.	37.78
791	Fessenden Drug Co., Fessenden, N. D.	38.12
792	John F. Murphy, Richardton, N. D.	36.45
793	City Drug Store, Kramer, N. D.	28.97
794	City Drug Store, Kramer, N. D.	37.64
795	Wm. G. Buehring, Anamoose, N. D.	37.91
796	Wm. Coghlan & Co., St. Johns, N. D.	36.63
797	Witmer & Derby, Bathgate, N. D.	38.04
798	Halbkat & Co., Webster, N. D.	37.04
799	A. E. Rowan, Thompson, N. D.	38.81
800	S. P. Tangen, Pekin, N. D.	29.4
801	Ruso Drug Co., Ruso, N. D.	36.66
802	Wood Drug Co., Oakes, N. D.	37.39
803	Fout & Porterfield, Fargo, N. D.	37.65
804	McVille Drug Co., McVille, N. D.	37.69
805	A. Kraft & Co., Hoople, N. D.	36.39
806	A. Kraft & Co., Hoople, N. D.	37.70
807	A. Kraft & Co., Hoople, N. D.	37.70
808	S. L. Harris, Oakes, N. D.	37.55
809	Geo. Netcher, Emerado, N. D.	36.43
810	Geo. Netcher, Emerado, N. D.	36.02
811	Perth-Amboy Chemical Works, Perth Amboy, N. Y.	37.41
812	Foogman Drug Co., Hillsboro, N. D.	39.06
813	Foogman Drug Co., Hillsboro, N. D.	37.88
814	Bruno Kretschmar, Kramer, N. D.	28.56
815	Dakota Drug Co., Upham, N. D.	38.00
816	M. V. Larson, Fullerton, N. D.	38.63
817	C. M. Glenn & Son, Merricourt, N. D.	36.61
818	L. H. Miller, Kermit, N. D.	39.01
819	Fessenden Drug Co., Fessenden, N. D.	37.88
820	Wm. Jacoby, Kramer, N. D.	36.40
821	Harken Olson, Ray, N. D.	38.40

LIGNITE COAL

The following samples of lignite coal have been analyzed:

224 S. From Herman Hanson, Turtle Lake, N. D.

234 S. From Ira Farringer, Bowdon, N. D.

235 S. From Ira Farringer, Bowdon, N. D.

248 S. From A. C. Burke, Donnybrook, N. D. From a vein near Foxholm averaging about nine feet in thickness.

257 S. From G. E. Schlechter, Bowdon, N. D.

	224	234	235	248	257
Moisture	27.27	14.11	12.25	21.43	13.78
Volatile carbon	41.72	43.67	38.00	48.89	44.01
Fixed Carbon	25.64	38.92	34.73	25.03	34.40
Ash	4.90	3.31	14.94	4.65	7.81
Sulphur	.42				
	100.00%	100.00%	100.00%	100.00%	100.00%

The following disinfectants and exterminators were submitted for examination with results as indicated:

237 S. Colorless disinfectant, Chemical Supply Co., Cleveland, Ohio, sent in by F. O. Hellstrom, Bismarck, N. D. Analysis showed it to be a solution of zinc chloride.

248 S. Marked Bug Exterminator, Chemical Supply Co., Cleveland, Ohio, sent in by F. O. Hellstrom, Bismarck, N. D. Was found to consist entirely of kerosene.

239 S. Soluble Pine Oil Disinfectant, Chemical Supply Co., Cleveland, Ohio, sent in by F. O. Hellstrom, Bismarck, N. D. An examination showed it to contain resin oils or some of their homologues, and indicated it to be the waste product from turpentine stills or from turpentine refining.

240 S. Coal Tar Disinfectant and Dip, Chemical Supply Co. Cleveland, Ohio, submitted by F. O. Hellstrom, Bismarck, N. D. The active principle was found to be quinoline, no cresol or crysilic acid being found. Not as represented by the Company, since the greater part distills at 240 degrees Centigrade.

245 S. Creolium, sent in by J. E. Phelan, Dickinson, N. D. When diluted with water gives a white, curdy precipitate. Treated with caustic soda it dissolves to form a brown solution. Treated with ferric chloride it does not give a color reaction, showing the absence of phenol products. At 100 degrees Centigrade a very small amount of water distills over. At 110 degrees about ¼ of the product distills which burns and reacts like kerosene. At 150 degrees Centigrade there distills over a very small amount of yellow oil. At 200 to 225 degrees Centigrade about ¼ of the product is distilled as an oily-like body having the appearance of a paraffin. Examination indicates that the product is a residue from a petroleum distillery, to which has been added a little kerosene. All the fractions burn with a smoky flame.

249 S. Marked Mineral Heave Powder, sent in by O. H. Hansen, Lidgerwood, N. D. A qualitative test showed it to consist largely of calcium carbonate with a small amount of starch and sulphur and slight amounts of alumnum, magnesium, iron sulphates and chlorides.

253 S. Leather. This sample was submitted to the Laboratory to be examined and was found to consist of ground up leather, glue, coloring matter and some vegetable fibre.

FLAXSEED

Several samples of flaxseed submitted to determine the per cent of oil which they contained, together with the moisture, gave results as follows:

	Moisture	Fat
1446	2.48%	36.73%
1689	2.64	32.47
1645	2.80	29.27
609	2.86	31.51
155	2.19	35.52

SODIUM ARSENITE

Several samples of sodium arsenite, some supposed to be commercially pure and other products, were submitted to the Laboratory for examination:

247 S. Purchased from a local drugstore, and was found on examination to be, not sodium arsenite, but sodium arsenate.

264 S. Marked sodium arsenite, Technical Special, Eimer & Amend, New York.

265 S. Sodium arsenite, No. 2, Technical, Eimer & Amend, New York.

265 S 3. Sodium arsenite, Technical, Eimer & Amend, New York.

266 S. Sodium arsenite, Pure, Mallinckrodt, St. Louis, Mo.

267 S. Sodium arsenite, Merck & Co., New York, marked Technical.

	264	265	265	266	267
Total arsenic	24.64	23.84	.....	.....	.....
Sodium arsenite	62.60	55.16	0	100.00	98.00
Sodium arsenate	.64	6.40	62.26	0	trace

SUGAR BEETS

Several samples of sugar beets have been examined to determine the per cent of sugar in the beets themselves, with results as follow:

No.		Per cent
1.	Martin Erickson, Galesburg, N. D.	12.60
2.	C. I. Edwards, Mayville, N. D.	14.00
3.	R. W. Jones & Son, Clifford, N. D.	12.80
4.	R. B. Griffith, Grand Forks, N. D.	4.60
5.	C. I. Edwards, Mayville, N. D.	14.60
6.	C. I. Edwards, Mayville, N. D.	13.60
7.	Dr. Geo. Boody, Hurdsfield, N. D.	14.20
8.	Dr. Geo. Boody, Hurdsfield, N. D.	17.00
9.	Martin Erickson, Galesburg, N. D.	14.00
10.	R. W. Jones & Son, Clifford, N. D.	15.80
11.	C. I. Edwards, Mayville, N. D.	14.40
12.	C. I. Edwards, Mayville, N. D.	15.80
13.	Dr. Geo. Boody, Hurdsfield, N. D.	12.20
14.	C. I. Edwards, Mayville, N. D.	14.40

STOCK FOODS AND FEEDING STUFFS

Lab. No.

114 Prussian Stock Tonic, Prussian Remedy Co., St. Paul, Minn.

115 Poultry Compound, McConnon & Co., Winona, Minn.

116 Stock Tonic, McConnon & Co., Winona, Minn.

121 Clover Brand Stock Tonic, Stock Food Co., of America, Minneapolis.

122 German Medicated Stock Food, German Medicine Co., Minneapolis, Minn.

123 Gold Coin Horse Tonic, Gold Coin Stock Food Co., Chicago, Ill.

126 Mixed Poultry Food, Northrup, King & Co., Minneapolis, Minn.

127 Sterling Hen Feed, Northrup, Knig & Co., Minneapolis, Minn.

130 Horse Tonic, Gold Coin Stock Food Co., St. Paul, Minn.

131 Hog Tonic, Gold Coin Stock Food Co., St. Paul, Minn.

132 Cattle Tonic, Gold Coin Stock Food Co., St. Paul, Minn.

133 Poultry Tonic, Gold Coin Stock Food Co., St. Paul, Minn.

137 Dr. Jansen's Stock Food, Dr. Jansens' Medicine Co., Minneapolis, Minn.

139 Warde's Poultry Tonic, Dr. Warde's Medical Co., Winona, Minn.

140 Warde's Stock Tonic, Dr. Warde's Medical Co., Winona, Minn.

ANALYSIS OF STOCK FOODS.

Lab: No.		Moisture	Ash	Fat	Proteids Nx6. 25	Crude Fibre	Nitrogen Free Extract
114	Prussian Stock Tonic	5.28	16.69	7.26	11.88	9.78	49.11
115	McConnon's poul. com.	3.75	30.02	2.89	15.37	6.60	41.37
116	McConnon's Stock Tonic	4.45	19.16	4.75	12.75	19.15	39.44
121	Clover brand St'ck food'	7.29	20.98	5.86	13.31	31.02	31.54
122	Germ. Medicat'd St. F'd	7.90	10.17	7.56	16.93	9.13	48.31
123	Gold Coin Horse Tonic	10.31	10.34	3.35	13.15	7.95	52.68
126	Northrup-King's P'y Fd	7.93	2.56	5.35	14.31	4.85	65.00
127	N-K's Sterling Hen Fe'd	9.15	4.05	3.23	12.19	3.04	68.34
130	Gold Coin Horse Tonic	4.83	18.36	7.86	12.06	11.01	45.88
131	Gold Coin Hog Tonic	4.69	20.55	30.32	11.68	17.62	32.73
132	Gold Coin Cattle Tonic	5.55	22.14	5.68	9.12	25.85	31.66
133	Gold Coin Poultry Tonic	5.50	18.28	4.28	9.62	21.26	41.06
137	Dr. Janes's Stock Tonic	5.46	20.25	4.58	13.12	7.84	48.75
139	Warde's Poultry Tonic	3.13	24.88	14.04	23.06	9.65	24.84
140	Warde's Stock Tonic	2.38	25.67	14.76	6.87	18.02	22.30

FEEDING STUFFS AND MILL FEEDS.

Lab. No.

117 Screenings, from C. E. Briggs, Neche, N. D.
118 Wheat Bran, Fargo Mill Co., Fargo, N. D.
119 Mixed Feed, Fargo Mill Co., Fargo, N. D.
120 Shorts, Fargo Mill Co., Fargo, N. D.
125 Alfalfa Meal, Northrup-King & Co., Minneapolis, Minn.
134 Wheat Bran, Goose River Mill Co., Mayville, N. D.
135 Shorts, Goose River Mill Co., Mayville, N. D.
138 Linseed Meal, Minnesota Linseed Oil Co., Minneapolis, Minn.

ANALYSIS

Lab: No.		Moisture	Ash	Fat	Proteids Nx6. 25	Crude Fibre	Nitrogen Free Extract
117	Screenings	5.16	4.97	6.74	11.18	13.79	58.16
118	Wheat Bran	5.31	7.30	5.07	14.00	12.06	56.26
119	Mixed Feed	4.85	5.24	5.05	16.06	8.98	59.82
120	Shorts	4.92	4.58	6.24	17.50	6.64	60.12
125	Alfalfa Meal	8.02	8.04	1.88	14.12	35.65	32.29
134	Wheat Bran	8.77		4.69	12.37		
135	Wheat Shorts	9.39		5.29	15.27		
138	Linseed meal	5.53	5.72	6.56	37.06	19.36	25.77

RECOMMENDATIONS AND ACKNOWLEDGMENTS

The analytical work reported in the preceding pages is largely the results of my assistants, who have performed carefully and efficiently all the work which has been assigned to them. I, therefore, desire to commend them for the efforts which they have put forth in furthering the work of the Department and for the cordial support which they have always given me.

The number of changes during the year in the staff of the department has tended to very materially weaken the work, several of my assistants having been induced by other institutions, offering better salaries, to take places in their laboratories. Such frequent changing in the laboratory force is always a source of great weakness wherever research work is being conducted, for whenever a man has become efficient in a particular line of work, if induced to accept a position in another institution, the Department must of necessity be seriously handicapped; and such has been the condition of the Chemical Department during the past year.

During the past year considerable attention has been given to experiments made in the experimental mill with samples of wheat drawn from various parts of the state; also baking experiments and gluten tests upon the products produced in the mill, and the chemical examination of the various products. It is believed that this line of work offers a field which will give valuable results not only in affording assistance to the farmers in the selection of varieties and strains of wheat, but also to the millers of the state, who may desire to have investigated the milling qualities of the wheats as used at the mills and the baking and gluten tests of the flours produced by the same. It is to be hoped that during the coming year this line of work may receive more attention and some financial aid as well from the state.

Respectfully submitted,

E. F. LADD,
Chemist.

DEPARTMENT OF BOTANY

DIRECTOR J. H. WORST:

SIR: The work of the Department of Botany of the Experiment Station for the year 1908 is in a large way a continuation of work as outlined in previous years and as especially planned and modified regarding soil and breeding studies in 1906 and 1907. The work has been carried on under both the Hatch and the Adams acts and consists of experiments conducted in the laboratory, greenhouse, and the field. Tho, a large amount of time has been given to correspondence and other educational phases of the work arising from the results of studies in previous years, most of the time has been given to the prosecution of the following lines of investigation:

1. Studies upon the bacterial and fungal flora of soils under special modes of treatment and fertilization. This work has been carried on in pot experiments in the greenhouse, and on large control plots in the field and by means of culture work in the laboratory.

2. Investigations upon fungi affecting farm and garden crops.

3. Breeding studies upon flax, wheat, and potatoes, by special methods of treatment and cropping with reference to the attacks of certain plant diseases.

4. Tree feeding experiments with a view to ascertaining the influences of such work upon large trees lately transplanted.

5. Weed Studies upon methods of eradication by spraying; studies upon poison plants, etc.

6. Investigation work upon seeds, especially clover, alfalfa and flax with a view to ascertaining special methods of germination and the condition of such seeds as found on the market, etc.

7. Garden studies upon native plants and weeds and general survey work upon native plants and plant diseases.

Soil Studies: As noted in the 18th Annual Report, field plots have been laid out for the purpose of the study of the effects of treatment, and fertilization of soils upon breeding and bacterilogical conditions. It is too soon to draw any general conclusions either from these field plots or upon the results obtained from the crop, but in many points very interesting data has been secured. It is evident that physical factors play a large role in the depletion of the crops as shown under the continuous cropping methods with wheat, flax, etc. Certain modes of treatment show that probably organic factors also play a large role. There is also other data secured to

show that certain types of fertilizers are of considerable value when properly applied to such old crop worn lands. The details of these matters must be left for discussion in special bulletins applying to the particular phases under consideration.

Plant Diseases: The studies upon smuts, rusts, wilts, and blights have occupied much attention during the growth season especially to learn the effects of certain methods of breeding and selection as bearing upon features of resistance of certain crops to such diseases. New methods of carrying out such studies have been carefully planned and we are able in most cases to subject our crops under study to thoro disease infection and also are able to largely vary the conditions of moisture and a number of other features which are necessary to make the disease studies intelligible. The results obtained from these studies make plain to us many disease and crop relations which were other wise difficult to understand. The influences of chemical fertilizers, etc., applied to the soil or upon the crop have given very considerable light. In general it may be noted that the attack of such diseases upon the crop can be largely influenced in an experimental way and that our studies have advanced some features to the point where trials may be made to ascertain whether these experimental efforts can be turned into practical field work in ways suited to farming operations.

We have, for example, found that certain fertilizers predispose a crop of wheat to rust, while certain others tend to break down the resisting power of wilt resisting flax. It is possible that such conditions are only indicative of unbalanced food relations of the crop and it is very probable that marked differences in soil and climatic conditions will largely influence such factors. However, the work we are doing is upon soil which is characteristic of very large areas of North Dakota which are of very even character thruout. It is possible that conditions or methods which we may develop may have a much larger application than would at first thought appear. The work with breeding and selecting flax for resistance to wilt and rust is an example in point. We now have strains of flax which are highly resistant, not only to wilt but to rust. A few years since we only believed that we could develop this wilt or rust resistant crop. During the seasons of 1907 and 1908 we have had rust resistant strains growing unattacked surrounded by thoroly attacked non-resistant strains, and both of these types have been selected from among our wilt resistant strains of flax which were originally breeded from individual mother plants. This is positive proof that such qualities can be developed in a pure strain of flax when the proper conditions are maintained consistently for a comparatively few years. It is one example which clearly points to the influences of conditions upon individual plants or crops in such a manner as to bring about heritable qualities. These qualities we have also found can be transmitted in crossing.

Distribution of Wilt Resistent Seed: This Department early developed the idea that it would be possible to procure disease resistant strains of certain crops, especially of flax. We had hoped to be able to give out seed to the farmers in the season of 1903 and 1904, but in our breeding processes we learned that our wilt resistant flax was much more subject to rust than common flax. It thus became neecssary for us to ascertain the reason for this. This we have done and find that it was due to the fact that all of the stages of flax rust grow upon the flax crop and that our method of constant cropping introduced the rust so that no plants had a chance to escape it. We then discarded all of our increase flax seed and proceeded to develop the original wilt resistant strains with the aim of procuring rust resistance, with results as noted above. This season we had a crop of approximately five acres of such seed in fine form but unfortunately during the harvest season all of this flax excepting a few individual selections was destroyed by hail so that we are again reduced to a point where we are unable to furnish any seed for distribution in quantity sufficient for a farmer to work with. During the season of 1907, however, we had increased the wilt resistant strain to the point where we were able to give out seed. And in the spring of 1908 we distributed approximately seventy samples of such wilt resistant flax to as many different farmers in the state. These seventy samples contained seven different strains, or pedigrees, that is, not all of the farmers received the same strains of flax seed. Some of the samples ripen much earlier than others, some are taller, some better yielders, and some more thoroly resistant than others. The amount of seed given out in each case ranged from one-half peck to one-half bushel. Instructions were sent to each person in regard to the kind of land on which to sow it and the mode of sowing, saving the seed, etc. With a few special exceptions the men were instructed to sow the seed received upon the sickest land available, and ordinarily no seed was given out except to a farmer that was known to have soil thoroly flax-sick. The reports on the results obtained from this seed were exceedingly encouraging. Only two persons have reported their check sample of ordinary flax as having done as well or better than the resistant sample. Some of the reports have shown very high yields. Three persons have reported over nineteen bushels of seed per acre on thoroly flax-sick land. Two writers have reported over twenty-five bushels per acre. These large yields are perhaps to be accounted for in the fact that the men have specially prepared the land. On the other hand it is also to be remembered that these yields have been given on thoroly flax-sick land where the ordinary flax along side died out completely. No matter how well the ground were prepared common flax would not grow there. In one of the cases in which the check excelled the resistant seed both samples were grown upon new land. In the other the sample was tried by a local breed-

er of flax seed against a sample of home grown high grade flax seed which had previously been grown three consecutive years upon that same flax-sick land. Thus the resistant flax was in competition the first year with a sample of home grown resistant seed grown after the very methods which this department has been recommending for a number of years. This only proves that the method which we have proposed is practical for use by the ordinary farmer and that if he proceeds properly he may practically immunize any sample of flax seed which he wishes to use on his own flax-sick soil.

Tree Feeding: The work in tree feeding was confined to feeding water and certain nutrients to large trees which were transplanted when in full foliage. The trees were over three inches in diameter and approximately twenty-five feet high and were set on the date of June 19th. The feeding commenced upon the same date that they were set. The unusual season of rain immediately following the work of transplanting has largely interferred with the possibilities of drawing conclusions from the work as undertaken but a number of points were added to our records of information upon this line of work. It was thought that should this prove practical many people who were interested in resetting very large trees might at least nurse such trees thru the first and second summer in such fashion as to prevent the usual loss from body starvation, the death of the tree usually taking place the second year because water and food materials stored in the trunk were exhausted the first season but not replaced. It will need further investigation to allow us to decide whether such work can be conducted in a practical way.

Weed Work: In March, 1908, this department published Bulletin No. 80 entitled "Weeds and Methods of Eradication" and, "Weed Control by Means of Chemical Sprays." The demand for this publication was so great that the edition was almost at once exhausted. We have had to re-issue parts of it as Press Bulletins, 25-26-27-28-29. These have been issued in large numbers and in the case of the one treating upon eradication of weeds in lawns and the one upon the eradication of mustard there have been two editions published. The Department took up the proposition of procuring a cheaper freight rating upon iron sulphate and other chemicals used in this weed spraying work. The original freight rating was on the basis that these substances were chemicals and made the freight very expensive. Working thru the authorities at Washington and the Interstate Commerce Commission and the different railway associations these efforts met with success and the freight rating has been materially reduced, especially upon the chief substance, iron sulphate. This places it upon a much cheaper local selling rate. This, together with a large amount of correspondence and work in drafting plans to aid the different spraying machine manufacturing firms in perfecting and modifying their sprayers to

meet the field conditions here in the norht west and to develop machines suitable for the large demand arising from the impetus given this weed spraying work in cereal grain fields, due particularly to our extended field demonstrations and other experiments, has occupied part of the time of the head of the department. But we feel that the work has been well spent, believing that for this northwestern cereal growing region we have developed a process which will very greatly aid in the control of weeds.

Much confusion has arisen in the public minds as to the merits of this process of destroying weeds. It is very difficult for some persons to understand that different plants have different powers of resistance. Others have been confused because they do not understand the difference between annual and perennial weeds. Many do not seem to make any distinction between a perennial such as the dandelion, or Canada thistle, and an annual such as mustard. The aerial portions of these weeds are equally easily destroyed by spraying processes, but the root of the dandelion and the under ground jointed stem of the Canada thistle may be expected to reproduce leaves and stems a number of times. Some people have condemned the process because they have not persistence enough to carry the work with the dandelions or the Canada thistles, as the case may be, to the end, and then figure up the cost to see whether it pays or not. Many of our best grain farmers say that it does pay. Many of the most able farmers and park and lawn producers in the country say that it pays.

Our own experiments during the past year have been largely conducted upon the college grounds in the trial of special chemicals upon special weeds and in extended trials upon the lawns of the College Campus where iron sulphate was used thruout the season and large field sprayers were used to do the work on the open areas and hand sprayers upon the lesser shrub covered areas. The iron sulphate was used in such quantities and at such times as necessary to hold the dandelions under control. Full notes were kept upon the cost of the work and the effects of the same, and the writer feels justified in saying that the work was accomplished with ease and efficiency and much more cheaply than the control of the weeds could have been obtained in any other known manner. On the sprayed areas no dandelions produced seed, and many of the large roots have totally disappeared. Young plants which came from the seed were destroyed completely, and we believe that another season will result in a complete cleaning up of the areas handled this year. The lawns on the sprayed areas made a strong growth of grass thruout the season; and areas which were originally almost thoroly occupied by dandelions became thoroly sodded with blue grass. I have further to report that the color of the lawn as observed by unprejudiced observers was greener and better thruout the fall than has been noted in previous years. This better growth

of grass and greener color compared with the unsprayed areas we have found to be largely due to the elimination of certain destructive parasitic diseases of blue grass, notable, the common mildews, and a smut, known as *Tilletia striaeformis*, the common rust of blue grass, and of numerous other indefinite fungi which are not common upon all areas examined. The grass on the sprayed areas remained green until late in the season, indeed, until snow covered it, while the unsprayed areas turned yellow and died early in the last weeks of August and early September. The dying was in part due to the fungi noted, and undoubtedly part of the greenness of the sprayed areas was due to a better type of chlorophyll production. Our spraying tests in wheat fields also show that certain sprayings appear to have had marked influence upon the strength of the rust attack. Whether this effect upon rust will eventually be found to prove a factor of economic importance in the field spraying work for the destruction of weeds must wait discussion for more extended experiments. I may say, however, that I have found that the yields of cereals may be increased in the general work of field spraying. This increase, according to the abundance of the weeds in the crop is variable. Other elements have also been observed which tend to account for the increase of grain and grass due to such weed spraying operations which can not be accounted to the destruction of weeds alone. A few of these points may be noted:

1. Iron sulphate or copper sprays undoubtedly increase the chlorophyll production under certain conditions.

2. In the case of spraying of wheat, the crop is left more open to light and air at the proper time for growth, and for this reason it makes a stronger and better growth and escapes, perhaps, to a certain extent rust and other fungous diseases because of such better aeration.

3. As indicated, the sprays are destructive to germinating spores of parasitic fungi. They attack all diseased or partially dead portions of the grass and grain leaves, and thus tend to destroy the pustules which are breaking out on the surface of the wheat and other grass leaves, preventing the formation of new spores. To this extent, should the spraying chance to come upon a field of grain at just the time when the first spore formation of rust was occuring it is plain that a large influence on the final amount of rust attack might easily be exercised, and this may, in part, account for the large increase in yields that have been reported by some of our farmers as due to spraying.

4. Certain elements of proper weed destroyers have fertilizer value, which may act either directly or indirectly.

5. Some of the substances may act as simply growth stimulants.

6. Some sprays have been found to extend the vegetation period. This is usually sufficient to account for increased yields

in cereals. This has been observed to occur in the spraying of wheat, oats, and lawn grasses.

Problems Associated with Future Work: The present status of the work has been arrived at largely by empirical methods. Future field operations may yet be largely modified because of results obtained in detailed investigations upon specific problems. Thus, it may be said that the whole question of why sprays kill or do not kill in specific cases is at present open for investigation. Aside from the general conditions of growth, light, heat, and water, (weather conditions) that are vital to the principles of success in this field spraying work, there are chemical and physical actions which, if well understood, would specifically account for the actions of specific chemicals upon specific plants. Were these matters better known it seems possible that more pointed directions might be given the farmer as to how and when to spray. One can only propose possible conjectures as to the underlying specific activities of a particular chemical. It is an interesting fact that numerous quite different chemical solutions of weak strengths sprayed upon the mustard plant bring about its death; but the rate of dying is very variable and the apparent physical and physiological actions are usually quite dissimilar. Again plants with heavy bloom, waxy covering, are markedly resistant to the different herbicides, tho like the grasses and grains readily succumb to any one of the sprays when bruised.

These observations, taken with other known physiological activities of protoplasm make it safe I think to assume that each chemical solution may affect the death of the living plant substance because of a number of different qualities, acting separately or together, as for example, intense withdrawal of water (*plasmolytic* action), the formation of new compounds within the plant cell, inimical to life processes, or thru disorganization processes (oxidation or reduction). Thus, it is probable that the common salt solution owes its rapid affects upon King-head and Canada thistle to the direct withdrawal of water. It has also been suggested that the sulphur of certain plant contents may unite with the iron of the iron sulphate spray to form an iron sulphide, a strong plant poison.

In my own observations upon the killing process I note that it is the powerful absorbers of oxygen (reducers) which are the most effective herbicides. For example, ferrous-iron ($FeSO_4$) is better than ferric iron (Fe_2SO_4) and sodium arsenite ($NaAsO_2$) is much more effective than sodium arsenate (Na_2HAsO_4).

Problems for Exact Investigation: Such questions are largely problems for exact investigation. There is much work which should directly interest the chemist, physicist, and physiologist. It may easily be possible to solve many of the problems connected with the development of these processes in an empirical way, as has been done in the past, determining particularly environmental conditions

(local conditions, etc). It will, however, be difficult to generalize as to the methods to be pursued without some exact data as to the underlying causes affecting specific actions. What for example, accounts for the effects of each particular chemical upon each particular plant or type of plant? What accounts for the influences of the sun, rain, dew, and frost upon the spraying operations? It is particularly evident that each of these elements are directly influential, and that they vary. What slight conditions influence the action of each type of chemical in its proper action upon the particular weed or crop involved? What changes do soils undergo because of the application of the chemicals? etc. That this last feature is an important one is evident for it is observed that iron sulphate, and copper sulphate solutions seem more effective against mustard and more beneficial to the cereals in case of lime bearing soils than in the case of non-calcarious soils. I have also observed that under certain soil conditions it is more difficult to destroy dandelion roots by spraying than under certain other soil conditions. Again it becomes more and more clear that the specific nature of the plants decide as to what chemicals should be used against them. For example, Canada thistle wet very readily, yet iron sulphate which is so destructive to mustard and King-head has very little effect upon this weed, while sodium arsenite and sodium chloride at once set up very destructive physiological actions. Such problems are ones which can be settle only by exact physiological and chemical studies. Indeed, the whole problem of what definite actions bring about the death of plants in the specific cases thru the action of the sprays are matters of direct importance in order to formulate proper statements as to what to use, and how to use it in this new field of endeavor for cleaner and more profitable crops.

Practical Problems: It is specially important that attention be centered upon the effectiveness of the sprays now in general use for weed destruction to determine their influence upon the development and distribution of the spores of parasitic fungi in cereal fields. By empirical trial it may be settled what type of solution is most beneficial, and what methods of spraying are most effective in this regard, and especially attempts should be made to determine for a given locality the stage of crop development with the time of rust attack, thus fixing the time which will most nearly fit into the proper time for destroying weeds, for it is evident from results already observed that it may be possible that this element of disease inhibition may be one of the greatest reasons for carrying out the process of general field spraying in cereal grain fields. Furthermore, the grain aphis is worthy of attention under this line of consideration. There is also a large field of work in preparing a type of spray which will attack bloom covered weeds such as perennial Sow-thistle.

The Machinery Problem in Weed Spraying: The feature of the greatest difficulty in introducing the weed spraying work has been the lack of machinery directly suitable for the work. However, this question is in a large way now likely to be quite efficiently solved by the different manufacturers of spraying machinery. At first they did not care to even establish agencies in the northwest not realizing the field open to them, but this is now overcome by the proofs that we have submitted to them, and a number of the best spraying machinery firms have made every effort to fit their machines to the work, and have established agencies.

Increased Yields Due to Weed Spraying: Tho many farmers were late in procuring either the machinery or the necessary chemicals for the field work during the season of 1908, many attempted the work in a large way and we have received numerous reports of such marked success that there can no longer be any doubt but that this method of holding weeds in cereal culture under control will prove to be a great success in the hands of the average farmers. Weeds are not only destroyed but the yields of grain are increased, even beyond the expectations of the most enthusiatic believers in the work. One writer in this state asserts that the increased yield from fifty acres of wheat paid all costs of work and materials and machinery, besides preventing the weeds on the areas sprayed from producing any seeds. Other farmers who worked upon Canada thistles report that tho they did not kill the roots that no thistles produced seed, even after one spraying. Others reported that with two sprayings of iron sulphate they have destroyed the thistles and some have reported absolutely to have destroyed the thistles with one spraying where sodium arsenite was used.

The effect of Weed Spraying Chemicals on the Soil: Continuing our work of 1906 and 1907 we have applied to the soil large quantities of certain chemicals used in weed spraying. We have used such quantities as to insure us that the quantities used in ordinary weed spraying work would not, in years, have any effect in bringing about a sterility of soil, at least under our conditions.

Poison Plants: Numerous reports continue to come in indicating that stock has been poisoned by the easing of various types of native plants. Among the plants most often accused is that of Water-parsnip (*Sium cicutaefolium*). This plant often grows associated with Water-hemlock. Nevertheless, we have this year received complaints against this weed, in neighborhoods where no Water-hemlock could be found. We therefore undertook to carry out some experiments to settle the question whether this plant is really a poisonous one or not. We have done considerable work using guinea pigs as the subjects upon which to experiment. We have not arrived at any conclusions which would sanction any publications of the details. The experiments will be continued during the coming season upon a larger and more extended plan.

Seed Studies: Tho the Experiment Station has not been furnished by the state any definite fund to conduct this work we have deemed it of so much importance that we have continued to do a large amount of seed examination, analysis, and testing. This season we have placed most of the work upon clover and alfalfa and have been surprised at the quality of the seed that is commonly offered on the market. Sometimes it is extra good, but usually we are able to trace such seed to the local or home grown products. More often the seed is found to contain a large percentage of dead seed in it, so much that our farmers can ill afford to pay the penalty arising from the purchase of such seed. Again such samples are often found to contain quite a large percentage of the worst weeds known to agriculture. At your request, and at the request of a number of representatives in the legislature, the head of the department has spent considerable time in the study of the question with a view to having drawn for consideration of the legislature of the state a seed bill which shall be of simple nature, yet effective in protecting the farmers of the state from such adulterations as have been noted. The draft of such a bill has been attempted, and we believe that we have submitted to the legislature a bill which will not only prove beneficial to the farmers but to the local seed houses in the state. It is to be hoped that our legislature will find it desirable to enact such a bill into law, or at least one which covers essentially the same features. We have also in this connection drafted a complementary bill in the shape of a weed law, looking toward limiting the dissemination of weed seeds in farming lands, and in the vacant lands of the state, whether in the country or in incorporated cities and villages. This has been a more difficult task and we hope that it may at least suggest some ideas towards a proper solution of this question as many people are demanding that the legislatures should enact laws which will tend to serve the purpose of checking the spread of such noxious weeds as Canada thistle, Sow-thistle, Quack-grass, Dodder, etc. The seed Bill mentioned has been introduced as Senate Bill No. 119. A draft of this proposed bill is here appended to show the features which are believed to be essential.

A BILL.

For an Act to Regulate the Selling, Offering or Exposure of Seeds for Sale:

Be it Enacted by the Legislative Assembly of the State of North Dakota:

Sec. 1. Seeds, How Labeled or Branded. Each and every package or lot of seeds, whether in package or in bulk, which is sold, offered or exposed for sale by any person, firm or corporation in the State of North Dakota shall be plainly, legibly and indelibly labeled in English upon the exterior of the container with a written or printed label. Such label shall show:

First. The commonly accepted name of the kind and variety of seed.

Second. The full name and address of the person or persons, firm or corporation selling, offering or exposing the seeds for sale.

Sec. 2. Mixed Seeds, How Sold. In case of sale, offering or exposure for sale of mixed seeds, the packages or containers shall be plainly labeled upon the exterior of the container with the correct common names of the kinds or varieties of seeds composing the mixture.

Sec. 3. The sale of Agricultural Seeds Containing Seeds of Noxious Weeds Which are Forbidden or Unlawful. No person firm or corporation shall sell, offer or expose for sale or for distribution in the state any agricultural or garden seeds which contain any of the seeds of Couch- or Quack-grass, Canada thistle, Sow-thistle, or Dodder. And, the sale of agricultural or garden seeds containing more than a reasonable trace of the seeds of Greater ragweed, Corn flower, Marsh elder, Russian pigweed, Dandelion, Chickory, Russian thistle, Plantain, Buck plantain, Bracted plantain, White cockle, Night-flowering catchfly, Pink cockle, Corn cockle, Cow cockle, Curled dock, Sorrel, Sheep-sorrel, Purslane, Bindweed, Wild buckwheat, Wild onion, Wild oats, Pigeon grass, Holy grass, Canada Blue grass, Chess, Mustard, Tumbling mustard, Hare's-ear mustard, Penny-cress, Pepper-grass, Shepherd's purse False flax, Bird's-foot trefoil, Yellow trefoil, Burr clover, Sweet clover, Ergot, or of the seeds of any other noxious weeds is unlawful.

Sec. 4. Mislabeling or Misbranding Seeds. It shall be unlawful for any person, either for himself or while acting as agent or servant of any other person, firm or corporation, to sell, offer or expose for sale, or to deliver within the state of North Dakota any seeds which are misbranded within the meaning of this act. Seed or seeds shall be deemed to be misbranded if the contents of any sack or lot of seeds, whether in package or in bulk containers is not labeled in accordance with the requirements of Sections One, Two, and Six of this act, or if such seed or seeds be falsely labeled in any respect.

Sec. 5. Penalty for Violation of Act. Whoever sells, offers or exposes for sale or for distribution in the state any seeds without complying with the requirements of Sections One and Two of this act, or in violation of Sections Three and Six of this act, shall be deemed guilty of a misdemeanor and on conviction shall be fined not less than ten dollars ($10.00) and costs nor more than one hundred dollars ($100.00) and the costs of the prosecution for the first offense, and not less than one hundred dollars ($100.00) and costs nor more than five hundred dollars ($500.00) and the costs of prosecution for the second or any subsequent offense.

Sec. 6. Sale of Seed for Manufacture, Food or Forage Uncleaned Seed, and Seeds in Transit. The provision of this act shall

not apply to any person, firm or corporation growing or selling or exposing for sale cereals or other seeds for manufacturing purposes, for food or forage, or to the sale or exposure for sale of uncleaned seed, provided each package, lot or bulk of such uncleaned seed sold, exposed or offered for sale be plainly labeled with the words, "Uncleaned Seed," and provided that no such uncleaned seed shall be sold or distributed within the state for sowing purposes; nor shall it apply to seeds in transit.

Sec. 7. The North Dakota Agricultural College Experiment Station to Inspect, Analyze and Test Seeds. The North Dakota Agricultural College Experiment Station at Fargo shall inspect, examine, and make analyses of or test seeds sold, offered or exposed for sale in the state at such time and places and to such extent as it may determine. The Director of said Experiment Station is hereby authorized to appoint a State Seed Commissioner and such other agents as he may deem necessary to carry out the provisions of this act, and said commissioner or agents shall have free access at all reasonable hours upon and into any premises or structures to make examinations of any seeds, whether such seeds are upon the premises of the owner of such seeds or on other premises or in the possession of any warehouse, elevator or railway company; and upon tendering payment thereof at the current value, may take from any person, firm or corporation any sample or samples of such seeds. The salary of said commissioner and of other agents shall be fixed and paid by the trustees of said Experiment Station.

Sec. 8. Citizens may Send Samples of Seed or Seeds for Analysis or Test. Any citizen of the State of North Dakota may, in accordance with regulations prescribed by the State Seed Commissioner, by prepaying the transportation charges, send a sample or samples of seed to said Experiment Station for examination, analysis or test, and such sample or samples shall be examined, analyzed or tested and reported upon free of charge.

Sec. 9. Certificates as Evidence. The certificate of the botanist of the North Dakota Agricultural College Experiment Station at Fargo, giving the results of any examinations, analysis or test of any seed sample made under the authority of said Experiment Station shall be presumptive evidence of the facts therein stated.

Sec. 10. Facts, How Transmitted. When said Experiment Station shall find by its examinations, analyses or tests that any person firm or corporation has violated any of the provisions of this act, the State Seed Commissioner may transmit the facts so found to the Attorney General or to the State's Attorney of the county in which the offense was committed or the misbranded seeds were found.

Sec. 11. Duty of Attorney General and State's Attorney. It shall be the duty of the Attorney General and the State's Attorney to prosecute all persons violating any of the provisions of this act

when the evidence thereof has been presented by the State Seed Commissioner.

Sec. 12. Station to Make Report. The North Dakota Agricultural College Experiment Station thru the state Seed Commissioner shall make an annual report to the governor on or before December 1st upon the work done under this act, which report shall show the results of the inspection, examinations, analyses or tests made together with the date or dates of said inspection, examinations, analyses or tests, and may include the names of persons, firms or corporations having seeds under such inspection, examinations, analysis or test. The said Experiment Station may also publish Bulletins or press reports setting forth results of inspection, examinations analyses or tests conducted under the provisions of this act, which bulletins or press reports may include the names of the persons, firms or corporations having seeds under such inspection, examinations, analysis or test.

Sec. 13. Appropriation. There is hereby annually appropriated out of any money in the State Treasury, not otherwise appropriated, the sum of two thousand five hundred dollars ($2,500) to be paid to the Treasurer of the North Dakota Agricultural College Experiment Station at Fargo, and the same shall be expended for the equipment of a seed testing laboratory and in carrying out the provisions of this act. Said payment shall be made in four quarterly installments on the first days of July, October, January and April, and the State Auditor is hereby authorized and directed to draw his orders for suhc payments.

Hard Seeds in Legumes: In our studies we have arrived at the conclusions that certain German investigators are correct in the matter when they say that certain types of leguminous seeds are properly spoken of, not as dead seed, but as "hard seeds," ones which under ordinary conditions will not germinate. Student Assistant, Mercer, who has had charge of the seed testing work has been making certain definitely outlined studies upon this proposition with a view of ascertaining how generally the clovers and alfalfas found on the market contain hard seed, and if possible to ascertain practical means of treating such so called hard seed, or seeds containing hard seeds, so that they may give the full value of the viability of the sample. Experiments show that it is possible to cause such hard seeds to germinate and that it can be done without the costly machinery usually recommended by the German investigators, but as yet the processes which we have used have not been tried on sufficiently extensive scale to warrant us in the assertion that they will prove practical in farm operations, tho we have every reason to believe that this will be the end of the investigations now under way. Our tests already allow us to very quickly determine in a very efficient manner what seeds are hard and which

ones are dead; and this is of much value to us in testing the viability of such seed.

Garden Studies and Studies Upon Native Plants: The garden studies upon native plants have been continued and a number of different wild plants have been planted under such conditions that it allows us to make use of them for special studies in regard to plant diseases, etc. The plant survey, under charge of Professor Bell during the summer months has been continued in association with the geological survey. A full report of the work done by Professor Bell will be found in the forthcoming report of the geological survey. The plants there reported upon are the same as those reported on in the 18th Annual Report under the head of the "Plants of the Williston Area," with a number of corrections as to the determinations and a number of additions of new plants not then determined. During the summer season of 1908 Professor Bell's work was associated with the Richland County Survey. The plants of this survey are being determined by Assistant Professor Bergman, and will be included with the general notes of the survey in a future report.

In general the work of the department for the year has been one of very considerable progress because of the efficient help rendered by the Assistant Staff, which until this year had not been reasonably permanent. The long lines of experimental work which we have outlined in years previous are also beginning to show results which point out more clearly the proper field for application of the work of investigation forces. New rooms for seed and station work are badly needed because the present laboratories are badly crowded by the various lines of investigation and student work.

Respectfully submitted,

HENRY L. BOLLEY,

Botanist.

HORTICULTURE DEPARTMENT

DIRECTOR J. H. WORST:

SIR: The work of the Horticultural Department for the year 1908 was along the following principal lines:

FOREST TREE PLANTING

Five of the acre forest plots were planted in the spring of 1908. This planting was chiefly to replace the young trees which had been killed in the winter of 1907-08. The killing of these trees was due to the unseasonably warm weather in the months of January and February. The varieties planted were the Ponderosa pine, Austrian pine, Scotch pine, Jack pine, Siberian larch, Norway maple and Black walnut. The trees started well in the beginning of the season but suffered severely during the long summer drouth. It is likely that a large percentage of these will need again to be replaced during the coming season. Our experience so far in starting young coniferous trees on the open prairie has not been encouraging. It will doubtless be found that a considerable protection of other trees will be necessary in getting evergreens started. The Siberian larch made an excellent growth where it received some protection from the adjoining willows. This tree is looked upon as the one most likely to furnish posts in a comparatively short length of time.

The growth of the deciduous trees, particularly of the white ash, has been very satisfactory. The black walnut continues to make a good showing. In the fall of 1908 we planted six bushels of nuts obtained from points in Minnesota. The present indications are that this will be a satisfactory tree, for certain purposes at least. The Catalpa trees seem to be wholly unsuited to our climate. A few that have made some promise during previous years were practically all dead at the beginning of last season.

FRUIT TREES

The apple and plum orchard planted in the spring of 1907 came thru the first season in good shape and made an excellent growth in 1908. This orchard comprises some 300 trees. These were planted to take the place of the trees previously killed by unfavorable fall conditions followed by extreme cold winter weather. In spite of the drouth during the season the trees made a growth of from one to two feet and many of the plum trees had set fruit buds.

All of these trees were practically destroyed in the hail storm that came August 29th. It was hoped at the time that some of them would recover, but later examination has indicated that most all of them must be replaced in the spring. The older trees received much less injury and by careful heading back in the spring can probably be saved. Among the forest trees the Siberian larch was killed nearly to the ground by this storm.

SMALL FRUITS

In the fall of 1907 one acre was measured off and planted to strawberries for the sake of making a commercial experiment. This covers the cost of planting and the cost of plants and the care for the season. In spite of the weather during the greater part of the summer the plants of most varieties made a good growth and have set buds well for the coming season. A strict account will be kept of the different varieties and of the whole acre to determine what profit may be expected. The yield will undoubtedly be much less than it would have been with a normal rainfall during the last season.

Land immediately west of the creamery was put into preparation for the planting of bush fruits next season. Raspberries have not succeeded well on the land on which they have been planted because it is poorly drained. The new location will overcome this difficulty.

FRUIT IMPROVEMENT

As in previous seasons a large number of seedlings of apple and plum were started on the station grounds. The seed for this purpose was obtained from the hardiest and best strains that we had access to. Many of the apple seedlings started four years ago have shown their adaptability to our climate, and we are waiting to see what the outcome in fruit will be. A large number of our plum seedlings are going into fruit each year, showing a constant uniformity of improvement over the wild parents of three or four generations back.

VEGETABLES

The work with vegetables consist of a number of variety tests with celery, sweet-corn and tomatoes, and in addition the growing of select strains for the purpose of improvement. The result of this work was practically destroyed by the hail storm already spoken of. We succeeded in securing some of the seed from our select strains, but were not able to make a comparison between individual plants as in previous years.

LANDSCAPE WORK

A considerable amount of time was taken up in improving the grounds. This work was made necessary because of the erection of

new buildings and the change of drives. A considerable amount of ornamental planting was also carried out and a plantation of ornamental plants for breeding purposes started in the gardens.

EQUIPMENT

The construction during the season of a greenhouse plant has added materially to the possibilities for additional work for this department. The classes in Horticulture find the laboratory greenhouses well suited for their work. All of the houses have been operated sufficiently to show that they are very well adapted for the purposes required. With the completion of a laboratory as provided for in the plan, the department will be enabled to carry on practically any kind of work at any season of the year.

Respectfully submitted,

C. B. WALDRON.

Department of Veterinary Science

PRESIDENT J. H. WORST, DIRECTOR,
Agricultural College, N. D.

SIR: Permit me to make the following report on the experimental work done by the Veterinary Department during the year ending January 31, 1909.

This work consisted for a large part in the systematic investigation of a horse disease, known as swamp fever. This work has been carried on in a somewhat desultory manner for two years previous, but lack of funds and equipment prevented us to go into the question in a thoroly systematic manner, consistent with the great economic importance of the subject.

When last July a portion of the Adams fund became available for this Department, it became possible to begin a systematic investigation of the disease.

In the planning of the line of research to be followed, it seemed wise, first of all, to pay considerable attention to the etiology of the disease.

For this purpose a study was made of the bacteria found to exist in the blood and organs of such cases of spontaneous swamp-fever as could be secured. A great number of bacteria were isolated and studied, but as there seemed to be little or no connection between the organisms found, in different cases, it seemed proper to take into consideration the presence or non-presence of an invisible virus as the causative agent.

In our experiments it was found possible that the disease could be transmitted quite readily by injection of swamp fever blood into healthy horses purchased in a swamp fever free region.

It was also found that the blood serum of a case of swamp fever obtained by injection of virus of the third generation remained quite virulent after passing thru the Pasteur-Chamberland filter. This virulent serum, after filtering prove to be absolutely sterile as far as this could be ascertained by ordinary culture methods.

The results of our work thus seem to indicate that swamp fever is an infectious disease, and that the infective agent belongs to the class of the ultra-microscopic viruses. In our next series of experiments we hope to repeat those experiments with a view of testing the constancy of this feature.

During our investigations we also attempted to learn some-

thing definite of the clinical features of the disease. The practical results of our observations were rather scant. In our cases we found the symptom which could safely be regarded as pathognomonic. In the spontaneous form of the disease, a progressive anaemia and cachexia is quite common, but such a condition may be found in many other diseases. In some of our experimental cases there was no anaemia whatever at the time of death.

The patho-anatomy of swamp fever, as far as our investigations go at least, offers little that is characteristic. In some of the more acute cases there are lesions indicating septicaemia, in others again certain heart lesions are present, in quite a number the liver shows interstitial changes, while in many others there are no lesions at all.

While our stock of information on swamp fever is far from being complete, its transmissability seems to warrant the suggestion that it may be dangerous to permit a case of swamp fever to remain in a stable with healthy horses.

When the next installment of the Adams fund becomes available, we hope to underteake the ncessary studies in order to decide, whether or not, an artificial immunity against the disease can be obtained.

Aside of the work on swamp fever, this department was engaged in the preparation of the hog cholera serum, devised by Drs. Dorset, McBryde and Niles of the United States Department of Agriculture. The conclusions to be drawn from this work indicate that this method of immunization against hog-cholera, is immensely practical and that its rational application may be depended on to ultimately eliminate the disease from the swine herds of the country.

It was the intention of the writer to submit with this report in detail all data obtained in the work on swamp fever and hog cholera, but it was found impossible to carry this plan into effect, owing to the amount of work crowded on the personnel of this department. It is hoped that time for the arranging of data, etc., will be found in the near future and that the working force of this department will be so increased as to enable it to keep its experimental data of all kinds in shape for publication.

Respectfully submitted,

L. VAN ES.

STATEMENT

The United States Appropriations, 1907-1908.

RECEIPTS.	HATCH FUND	ADAMS FUND
To receipts from the Treasurer of the United States as per appropriations for fiscal year ended June 30, 1908, under acts of Congress approved March 2, 1887 (Hatch Fund) and March 16, 1906 (Adams Fund)	$ 15,000.00	$ 9,000.00
DISBURSEMENTS.		
By Salaries	8,314.68	6,333.32
Labor	3,033.69	1,184.80
Publications	1,016 26	
Postage & Stationery	254.88	
Freight & Express	76.97	61.44
Heat, Light & Water	395.25	
Chemical Supplies	47.32	49.55
Seeds, plants & sundry supplies	438.19	731.49
Fertilizers		17.60
Feeding Stuffs	764.86	
Library	72.51	
Tools, implements & machinery	303.32	148.97
Furniture & Fixtures	28.75	205.13
Scientific Apparatus	67.66	265.70
Live Stock		
Traveling Expenses	48.29	
Contingent Expenses	15.00	
Building & Repairs	122.37	2.00
Total	$ 15,000.00	$ 9,000.00

W. A. YODER,
Accountant.